Soils Work in Antarctica

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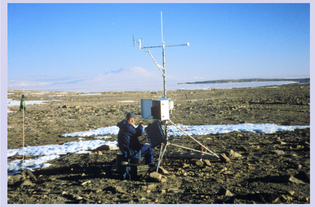

Photo 1. Climatic station being installed at the Marble Point site.

Photo 2. The array of sensors for the below-ground measurements.

Photo 3. The soil profile at the Marble Point site (sandy-skeletal, mixed superactive Glacic Haplorthel). There was no horizon development.

Introduction

In January 1999, sites were sampled and instrumented at Marble Point (coastal site, ice-cemented permafrost), Bull Pass in the Wright Valley (dry permafrost area), and Scott Base (ice-cemented permafrost). Data loggers were installed to collect climatic data at each site. Each site was sampled for chemical, mineralogical, and physical analyses. The data being collected will support a New Zealand project that is looking at the effects of oil spills on different soil properties. It will allow a better understanding of soils of this extreme environment. The data collected here will help record possible climatic shifts from climate change. These sites and other similar ones installed by NASA / University of Washington will provide a very valuable resource to modelers and others who use soils / climatic data.

Photo 1 shows one of the climatic stations being installed at the Marble Point site. For above-ground measurements, sensors were installed to measure wind speed and direction, air temperature, relative humidity, and solar radiation. Below-ground sensors were installed to measure soil temperature and soil moisture at several depths. Measurements are made every 20 minutes, averaged, and recorded every hour. For wind speed and solar radiation, measurements are made at 10-second intervals, averaged, and recorded every hour. Similar installations were also made at Bull Pass in the Wright Valley and at Scott Base.

Table 1. Selected Data for the Three Sites.

Depth cm	Clay %	Silt %	Sand %	15-Bar %	Field Water %	Conductivity Moisture mmhos/cm
Marble Point Site						
0 - 3	1.6	8.0	90.4	1.9	3.2	14.70
3 - 15	0.8	11.5	87.7	2.5	4.0	2.35
15 - 32	1.3	14.6	84.1	2.6	5.7	2.10
32 - 45	2.6	14.6	82.8	2.7	3.7	1.74
45 - 68	3.7	17.5	78.8	3.1	10.6	1.69
68 - 100	7.2	23.2	69.6	5.5		3.23
Bull Pass Site						
0 - 3	1.6	3.1	95.3	0.9	0.2	0.58
3 - 12	5.2	12.3	82.5	2.1	0.7	7.08
12 - 18	6.0	35.4	58.6	3.8	1.7	18.27
18 - 28	5.6	32.9	61.5	3.5	1.7	16.41
28 - 38	5.7	30.4	63.9	3.5	1.7	16.91
38 - 51	4.4	30.8	64.8	3.2	1.8	12.22
51 - 78	4.8	33.9	61.2	3.9	1.9	9.27
78 - 109	3.7	26.3	70.0	3.6	2.9	7.76
109 - 130	4.9	34.6	60.5	5.3	4.8	10.71
Scott Base Site						
0 - 1	6.7	11.5	81.8	5.4	1.5	3.41
1 - 7	6.2	11.2	82.6	5.3	4.0	1.68
7 - 15	5.0	8.4	86.6	5.4	5.2	0.24
15 - 30	4.5	9.5	86.0	4.5	5.6	0.11
30 - 45	2.9	25.5	71.6	5.1	21	0.26

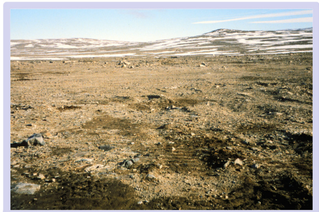

Photo 4. Landscape at the Marble Point site.

Photo 5. The landscape at the Bull Pass site.

Discussion

The data in Table 1 shows very low gramametric field moisture contents resulting in low heat capacity. At the Bull Pass site, the field moistures were well below the 15-bar water as they were in the top three horizons of the Scott Base site. The electrical conductivity of the saturation extract shows high levels of salts in the surface of the Marble Point site suggesting evaporation and precipitation of salts. There were many areas with salt crusts at Marble Point and at Scott Base. These crusts are shown in Photo 10. With the extreme dryness of the Bull Pass site, there was a salt build-up just below the surface.

The soil at Bull Pass had very little development and was almost white. The only development of color was under rocks where moisture seems to concentrate. Photo 11 shows the bottom of a rock from a 30-cm depth.

Initial soil temperature data indicated several freeze / thaw cycles within a brief amount of time although we were in a period of 24 hours of light (Figure 1). This data is from the site at Bull Pass. In addition, when clouds passed over the sun, the sensors at the surface would drop below 0°C very rapidly as they would when the sun was at its lowest angle. The data shows that the permafrost is at a depth of about 55 to 60 cm. In this profile, it is dry permafrost. In the other two sites, the bottom layers were ice-cemented. There was a slight moisture pick-up in the bottom of the profile at Bull Pass but not enough to cause ice cementing, because it was still below 15-bar water capacity.

Photo 6. The soil profile at the Bull Pass site (fine-silty, mixed subactive, hypergellic Typic Anhyorthel).

Photo 7. Soil profile at the Scott Base site.

Photo 8. Landscape at the Scott Base site. This soil was formed in basalt. There was not enough weathering to show any expression of andic soil properties other than sodium NaF pH's just greater than 9.

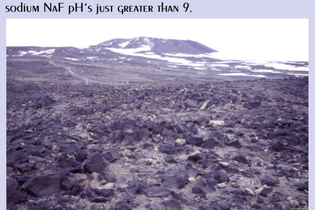

Photo 9. Salt crusts were observed in many of the soils.

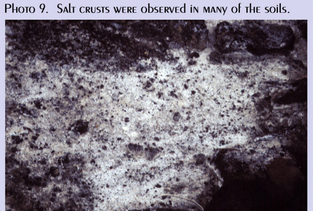

Photo 10. Rock weathering near the Marble Point site. The effects of many freeze / thaw cycles are very evident.

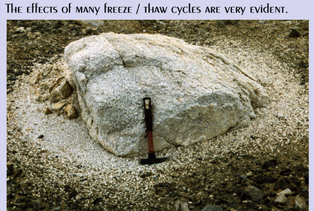

Photo 11. The bottom of a rock from the Bull Pass site.

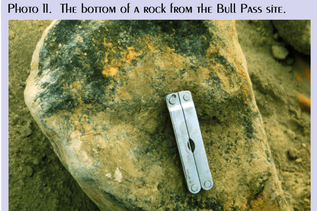

Figure 1. Initial soil temperature data.